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(56) Documents Cited
GB 2085460 A GB 2058806 A EP 0604815 A2
WO 91/18065 A1 US 5286288 A US 5041161 A
US 3993492 A

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(54) A phase change ink

(57) A phase change ink for printing a UV opaque image on to a printing screen carrying a stencil emulsion, the ink comprising a water soluble material having a wax-like texture and an opacity agent. The water-soluble material may be polyethylene glycols, polypropylene glycols, ethoxy steary alcohols, ethoxy stearamides, ethoxy castor oils and ethoxy hydrogenated castor oils.

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A Phase Change Ink

This invention concerns a phase change ink for use in an ink jet printer.

A phase change ink is an ink that is capable of changing its physical state.

EP 0 492 351B discloses an apparatus for preparing a printing screen for use in a screen printing process. In the process a graphic image is printed on to a printing screen carrying an unexposed photographic stencil emulsion using an ink jet printer. The printing screen is exposed to UV light and the graphic image masks the photographic stencil emulsion that it covers from the UV light. After the printing screen is exposed to UV light, it is washed to remove the photographic stencil emulsion that was protected from exposure to the UV light by the graphic image and, if the graphic image is water soluble, to remove the graphic image as well. The printing screen is then ready for use in a screen printing process.

Ink jet printers are available with a variety of printing heads including thermal bubble jet heads and heated ceramic piezo drop heads.

The use of a thermal bubble jet head with a water-based ink gives a low degree of resolution because the water-based ink spreads slightly when it impacts the printing screen. Silk screen stencils contain surfactant elements that promote spreading of the ink.

The use of a heated ceramic piezo drop head is preferred because it can be used with a phase change ink having a wax-like texture. The phase change ink having a wax-like texture does not spread as much as a water-based ink when it impacts the printing screen so it produces a higher degree of resolution. A higher degree of resolution enables better reproduction of original artwork.

Traditional phase change inks are based on hydrophobic hydrocarbon waxes, microcrystalline waxes, natural waxes, long chain fatty acids, long chain fatty alcohols and long chain fatty esters.

A disadvantage of using a traditional phase change ink is that it is difficult to wash the ink from the printing screen after the printing screen has been exposed to UV light. Also, when the phase change ink is finally removed from the printing screen, it comes away in large pieces which makes disposal of the ink difficult.

The present invention is concerned with the problem of providing an ink for printing a UV opaque image on to a printing screen carrying a stencil emulsion, the ink having good resolution and being easily removable from the printing screen.

In accordance with the present invention there is provided a phase change ink for printing a UV opaque image on to a printing screen carrying a stencil emulsion, the ink comprising a water soluble material having a wax-like texture and an opacity agent.

The inventors have found that since the phase change ink of the present invention is water soluble, it is easy to wash the ink off a printing screen carrying a stencil emulsion after the printing screen has been exposed to UV light.

The water soluble material having a wax-like texture preferably comprises at least one of the following materials: polyethylene glycols, polypropylene glycols, ethoxy stearyl alcohols, ethoxy stearamides, ethoxy hydrogenated castor oils and ethoxy castor oils. Mixtures of the aforementioned materials may also be used. Specific examples of compounds falling within these groups are: polyethylene glycol 400, polypropylene glycol 400, polyethylene glycol 600, polyethylene glycol 1500, ethoxy 20 stearyl alcohol, ethoxy 60 hydrogenated castor oil, ethoxy 50 stearamide and polyethylene glycol 600 mono oleate.

In order for the ink to be capable of being jetted from an ink jet printer, it is advisable for the water soluble material having a wax-like texture to have a defined melting range over a small temperature range, and a viscosity drop in the range of between 5 and 50 cp at jetting temperature. Viscosity drop can be determined using a rheometer. The above mentioned materials suitable for use as the water soluble material having a wax-like texture have been found to have suitable viscosities for incorporation into a jettable ink.

The ink of the present invention must comprise an opacity agent. The opacity agent is needed to provide opacity to the ink. The ink is required to be opaque so that it masks a photographic stencil emulsion on a printing screen from UV light. The opacity agent should be opaque in the UV region of 100-400 nm. The opacity agent may be a dye, a pigment, a UV absorber, or a mixture thereof. A dye is the preferred opacity agent. Examples of suitable dyes are: Solvent Yellow 16, Solvent Yellow 56, Solvent Yellow 174, Solvent Yellow 14, Solvent Orange 102, Solvent Orange 86, Solvent Red 1, Solvent Red 24, Solvent Blue 35 and Solvent Blue 79.

If a pigment is used as the opacity agent, it is important that the particle sizes in the pigment are below 1 micron.

The invention will now be described by reference to the following example:

Examples

The following water soluble, phase change inks were prepared:

Example 1:

Item	Material	%$^{w}/_{w}$
1.	Polyethylene glycol 400	33
2.	Hostafine Black	4

3.	Basacid Black X38	3
4.	Polyethylene glycol 1500	60

The ink was prepared by the following method:

Items 1 to 3 were mixed whilst warming to 60 °C. The mixture was then heated to 65 °C and item 4 was added slowly using a stirrer. It was important not to let the temperature fall below 60 °C.

The ink had a viscosity of 85cp at 80 °C, which dropped to 41cp at 110 °C.

Example 2:

Item	Material	%w/w
1.	Polyethylene glycol 400	43
2.	Hostafine Black	4
3.	Basacid Black X38	3
4.	Polyethylene glycol 1500	50

The ink was prepared using the same method as in Example 1.

The ink had a viscosity of 57cp at 80 °C, which dropped to 27cp at 110 °C.

The inks were tested by jetting them from a heated piezo head on to a printing screen carrying an unexposed stencil emulsion. The screen was printed under a yellow 'safe' light in order not to affect the unexposed stencil emulsion. The printing screen was then exposed to UV light and the stencil emulsion was developed using water. The screen was examined for the quality of the image.

The printing screen was used to print an image on to a paper substrate using a suitable printing ink. The quality of the image was examined.

The inks were also tested by jetting the ink from a heated piezo head on to a piece of transparent, 100 micron, polyester film. An area of 25cm x 50cm was covered with the ink. The printed polyester film was placed in a beam of a UV/Vis spectrometer and an unprinted polyester film was placed in a reference beam. The polyester films were scanned from 250mm to 450mm.

The absorption of light by the printed polyester film was used to determine the masking properties of the ink.

The inks were found to exhibit high resolution and they were easily removable from the printing screen.

Claims

1. A phase change ink for printing a UV opaque image on to a printing screen carrying a stencil emulsion, the ink comprising a water soluble material having a wax-like texture and an opacity agent.

2. The phase change ink claimed in claim 1, wherein the water soluble material having a wax-like texture comprises at least one of the following materials: polyethylene glycols, polypropylene glycols, ethoxy stearyl alcohols, ethoxy stearamides, ethoxy hydrogenated castor oils, ethoxy castor oils or a mixture of these materials.

3. The phase change ink claimed in claim 2, wherein the water soluble material having a wax-like texture comprises at least one of the following materials: polyethylene glycol 400, polypropylene glycol 400, polyethylene glycol 600, polyethylene glycol 1500, ethoxy 20 stearyl alcohol, ethoxy 60 hydrogenated castor oil, ethoxy 50 stearamide and polyethylene glycol 600 mono oleate.

4. The phase change ink claimed in any one of the preceding claims, wherein the opacity agent is a dye, a pigment, a UV absorber, or a mixture thereof.

5. Use of the phase change ink defined in any one of claims 1-4 in the preparation of a printing screen carrying a stencil emulsion for a screen printing process, the ink being printed on to the printing screen in the form of a graphic image.

6. A method of preparation of a printing screen carrying a stencil emulsion for a screen printing process, the method comprising the step of printing the phase change ink defined in any one of claims 1-4 in the form of a graphic image on to the printing screen.

7. A screen printing process for screen printing on to a substrate, the process comprising the step of using the printing screen prepared in claim 6 to print on to the substrate.

The Patent Office

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Claims searched: 1-7

Examiner: K. Macdonald
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Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): C3V(VAE,VBA)

Int Cl (Ed.6): C09D

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2085460 A	(CORNING GLASS) see Claim 1; Table on page 4	1 at least
X	GB 2058806 A	(GILLETTE) see Claims 1,9; page 3, lines 2-14	1 at least
X	EP 0604815 A2	(CERDEC) see Claim 2; page 5, lines 5-20	1 at least
X	WO 91/18065 A1	(COATES) see Claim 1; page 3, line 29-page 4, line 9	1 at least
X	US 5286288	(VIDEOJET) see Claim 1; column 5, line 59	1 at least
X	US 5041161	(DATAPRODUCTS) see Claim 1;Table I	1 at least
X	US 3993492	(WOOLLY) see Claim 1	1 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art
Y	Document indicating lack of inventive step if combined with one or more other documents of same category	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application